TECHNICAL SPECIFICATION FOR LIQUID PENETRANT INSPECTION

1 - OBJECTIVE AND FIELD OF APPLICATION

Liquid penetrant inspection is intended for the detection of defects open to the surface.

This method is generally limited to the inspection of finished castings. It may however be applied at earlier stages, especially for the inspection of excavations.

2 - SURFACE PREPARATION

It is essential that the surfaces to be inspected are clean and dry. That means that rust, scale, welding flux, spatter, grease, oil, water, dust, paint .. etc. are removed from the surface and the defects to be inspected.

Table 1
The surfaces shall be prepared according to acceptance criteria.

classes	Ra µm	Reference Plates			
		BNIF 359-01	Roughness test Nr 2 (LCA - CEA) Grinding	Roughness test Nr 3 (LCA - CEA) Grit blasting	ASTM A802
1	≤ 6,3	1S2, 2S2	≤ N9	prohibited	not applicable
2 to 3	≤ 12,5	1S1, 2S1 3S2, 4S2, 5S2	≤ N10	prohibited	not applicable
4 to 5	≤ 12,5	4S1, 5S1, 6S1	≤ N10	prohibited (*)	not applicable

(*) Sanding or grit blasting may be acceptable, subject to the Designer's approval.

In case of superficial mechanical treatment (e. g. scratching, hammering, shot blasting) which may dull the casting surface and thus hinder the penetration of the dye, the dye penetrant inspection should be preceded by a grinding of the surfaces to be inspected.

If magnetic particle inspection with liquid ink is intended, it is recommended to perform liquid penetrant inspection first.

3 - METHOD AND PROCESS

The general method uses a coloured water-washable liquid penetrant, visible in normal light, with which the surface to be inspected is wettend. The excess of penetrant will be washed of and the part dried. The examination is made after application of a coat of developer, suspended in a liquid. The products used shall be of high sensitivity.

The products generally available on the market and the operation methods described hereafter can be used within a temperature range of about 10 to 40° C of the surface to be inspected. Beyond these limits, the efficiency of the products and of the process must be proved at the temperature at which the inspection is intended to be carried out.

Any other method may be applied after previous agreement.

◆

3.1 CLEANING

Rust, scale, welding flux, spatter, paint etc. shall be removed by means of a wire brush or by grinding.Then any traces of dust or grease have to be eliminated from the surface by means of a solvent or by means of steamed water under pressure. The products used must meet the requirements of National legislation with regard to the environment.

3.2 DRYING

It is essential that the surface to be examined is completely dried prior to application of the penetrant.

3.3 APPLICATION OF THE PENETRANT

The penetrant may be applied by dipping, brushing or by spraying (Aerosol or compressedair-type apparatus). Minimum penetration (soaking) time is 10 minutes, but longer penetration times may be necessary on polished surfaces, narrow discontinuities or at temperatures below 15 °C.

Generally, soaking times will be 10 to 20 minutes. It must be assured that the surface is kept wet during this period.

3.4 EXCESS PENETRANT REMOVAL

After the required penetration time, excess penetrant is removed by means of a wet cloth (sponge), by water rinsing or water spraying, at a water temperature below 40 °C and at a water pressure of less than 3.5 bar. The water jet shall be at least 30 cm from the surface. Then the part will be immediately dried with a dry, clean and lint free rag. The drying may be accelerated by using dry non oily compressed air at a pressure of less than 2 bar.

3.5 DEVELOPMENT

The developer must be applied **immediately** after the part to be examined is dry.

As developer, a suspension of powder in a solvent is used. It is recommended to apply the developer by a pistol immediately after preparation (mixing, shaking) to inforce uniform suspension. Other application methods (eg. aerosol spray) may be used as well, if they assure a thin and even film of developer, without flushing the penetrant within the discontinuities. Thick coats of developer are unacceptable. Drying is produced by natural evaporation.

3.6 EXAMINATION

Due to the rapid diffusion of the dye in the developer, it is recommended to observe the evolution of indications since application of the developer. After a developing time of 10 to 20 minutes, the indications will be compared with the acceptance criteria. Lighting should be higher than 500 Lux.

4 - INTERPRETATION OF RESULTS

4.1 DEFINITIONS

«Indications» are any detectable bleedouts after application of the developer

«Relevant» indications are those resulting from discontinuities.

«Rounded» indications are those which are more or less elliptic and their length is less than three times the average width.

«Linear» indications are those, in which the maximum length represents mor than three times the average width extension.

«Aligned» indications are groups of three or more indications, aligned side by side, with a distance from edge to edge of less than 2 mm.

The «indications density» is the quotient (in 0/00) $\dfrac{\text{Total surface of indications taken into account}}{\text{Reference surface (1 dm}^2\text{)}}$

4.2 EVALUATION OF INDICATIONS

The threshold for taking the indications into account is defined for each class.

Surface imperfections, such as tool marks or other superficial surface conditions, are likely to produce indications. Any equivocal indication must be regarded as a defect and shall be re-examined, to verify whether or not real defects are present. Surface conditioning should precede the re-examination.

Broad areas of pigmentation are unacceptable without agreement of the Designer.

4.3 ACCEPTANCE CRITERIA

The inspected area Will be evaluated and classifed by comparison with the enclosed criteria which define five classes, numbered from 1 to 5 in decreasing order.

The reference surface of 1 dm2, taken into consideration for this comparison, may be a square or a rectangle anyway, its length may not exceed 250 mm) depending on the morphology and the dimension of the inspected area or according to the most disadvantageous repartition of indications within the area concerned.

Cases of special indications or linear indications, which obviously are impossible to class, should be subject to an additional investigation for each particular case.

5 - INSPECTION REPORT

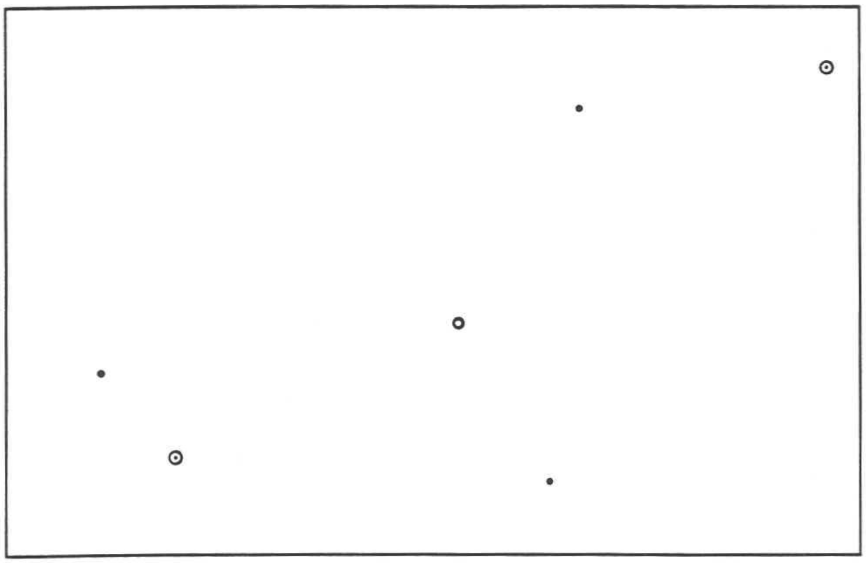
The inspection report shall include :

- Identification of the Founder, the Manufacturer or the Designer
- Identification of the casting (Heat Nr., traceability)
- Steel grade of the casting
- Designation of examination documents used: reference to the present specification, Quality sheet.
- Stage of manufacture at inspection
- Mode of surface preparation
- Designation of the products used
- Conditions of the inspection
- Inspected areas
- Results of inspection
- Name, signature and certification of inspector
- Identification of the firm in charge of inspection, if sub-contracted
- Date of inspection and signature of the responsible person for inspection

CLASS **1**

Acceptance criteria : (density 0,63 o/oo)

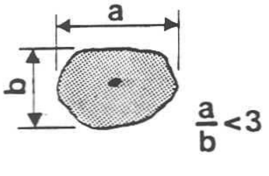
1) Threshold of accountability : a = 0,5 mm.
2) No rounded indication with a dimension of a > 2 mm.
3) No «linear» indication.
4) No «aligned» indication.
5) Total surface ot the indications in the range of 6 to 7 mm².



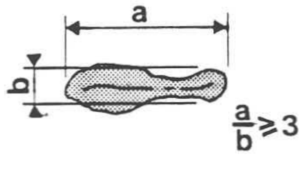
Note : As a reference, the above example contains 6 indications, all taken into consideration. (a > 0,5 mm).
The total surface thus taken into accont is of 6,3 mm².

Definition of indications : (See PT 70-3 paragraph 4.1)

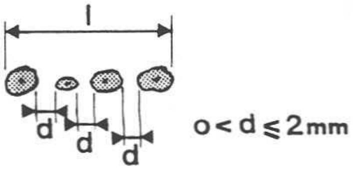
rounded



linear



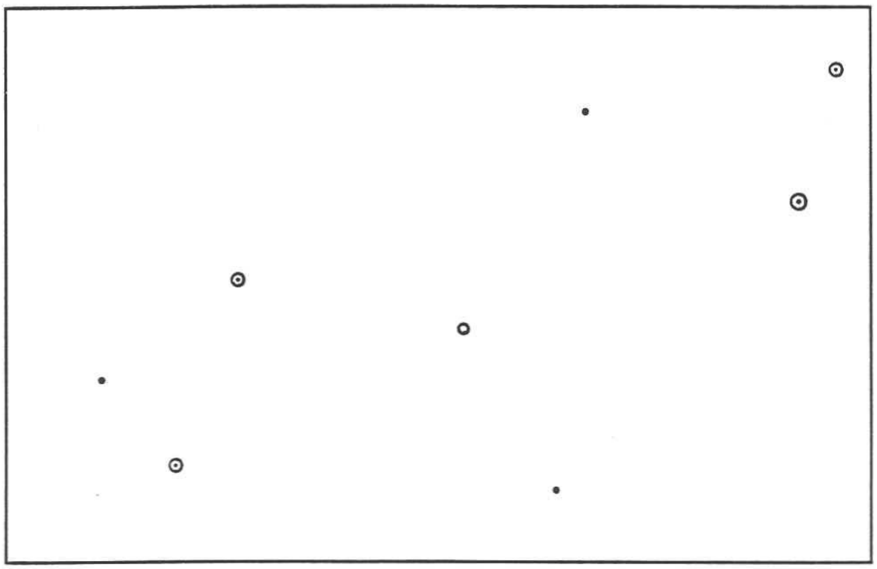
aligned



CLASS **2**

Acceptance criteria : (density 1,6 o/oo)

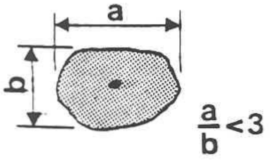
linear
1) Threshold of accountability : a = 1 mm.
arredondade
2) No rounded indication with a dimension of a > 3 mm.
3) No «linear» indication.
4) No «aligned» indication. extenção
5) Total surface ot the indications in the range of 16 mm².
TO



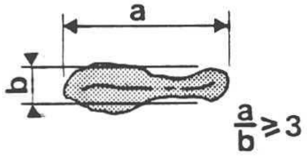
Note : As a reference, the above example contains 8 indications,
3 of which aren't taken into account. (a < 1 mm)
The total surface thus taken into accont is of 16 mm².

Definition of indications : (See PT 70-3 paragraph 4.1)

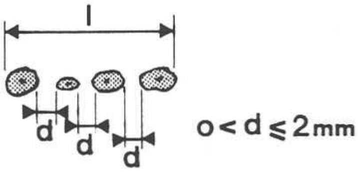
rounded



linear



aligned

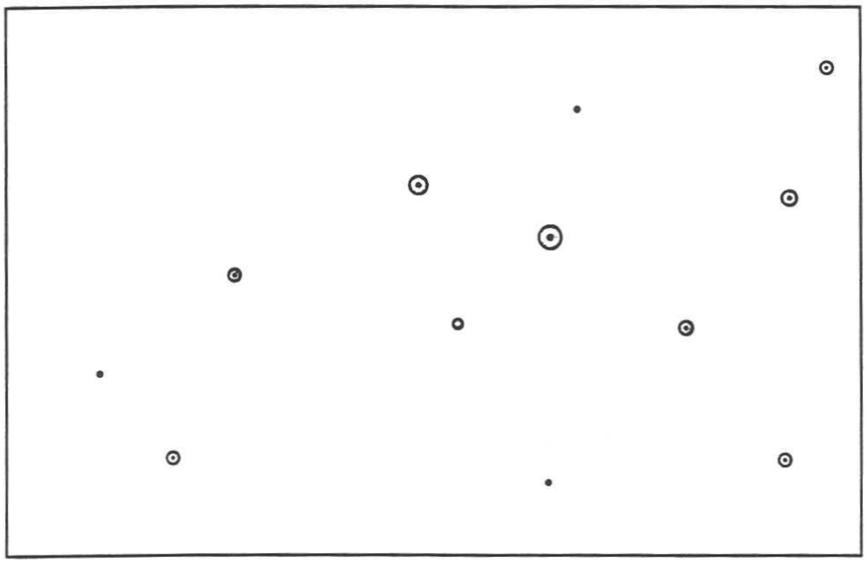


LP

CLASS **3**

Acceptance criteria : (density 4,0 o/oo)

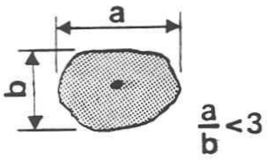
1) Threshold of accountability : a = 1,5 mm.
2) No rounded indication with a dimension of a > 4 mm.
3) No «linear» indication.
4) No «aligned» indication.
5) Total surface ot the indications in the range of 40 mm².



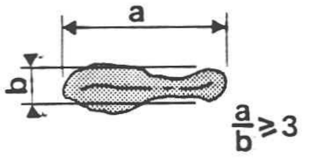
Note : As a reference, the above example contains 12 indications, 4 of which aren't taken into account. (a < 1,5 mm)
The total surface thus taken into accont is of 40 mm².

Definition of indications : (See PT 70-3 paragraph 4.1)

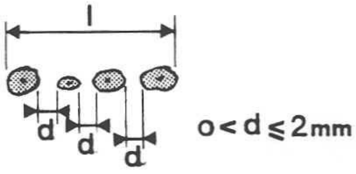
rounded



linear



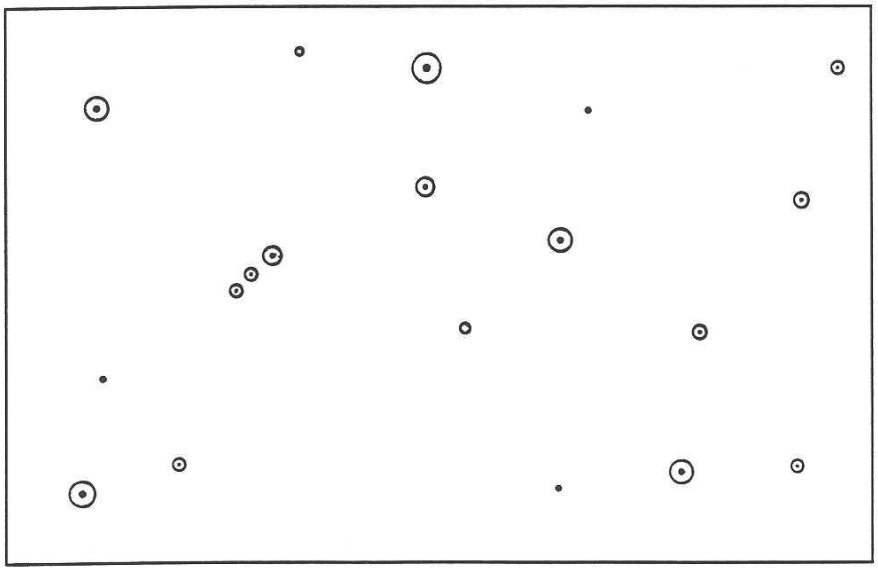
aligned



CLASS **4**

Acceptance criteria : (density 10 o/oo)

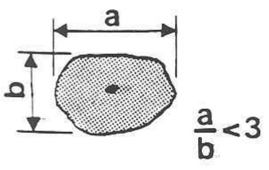
1) Threshold of accountability : a = 1,5 à 2 mm.
2) No rounded indication with a dimension of a > 6 mm.
3) No «linear» indication.
4) No «aligned» indication of l > 10 mm.
5) Total surface ot the indications in the range of 100 mm².



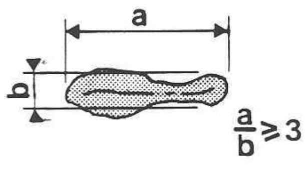
Note : As a reference, the above example contains 19 indications, 6 of which aren't taken into account. (a < 1,5 to 2 mm) The total surface thus taken into accont is of 100 mm².

Definition of indications : (See PT 70-3 paragraph 4.1)

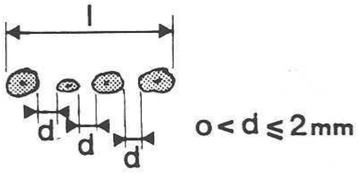
rounded



linear



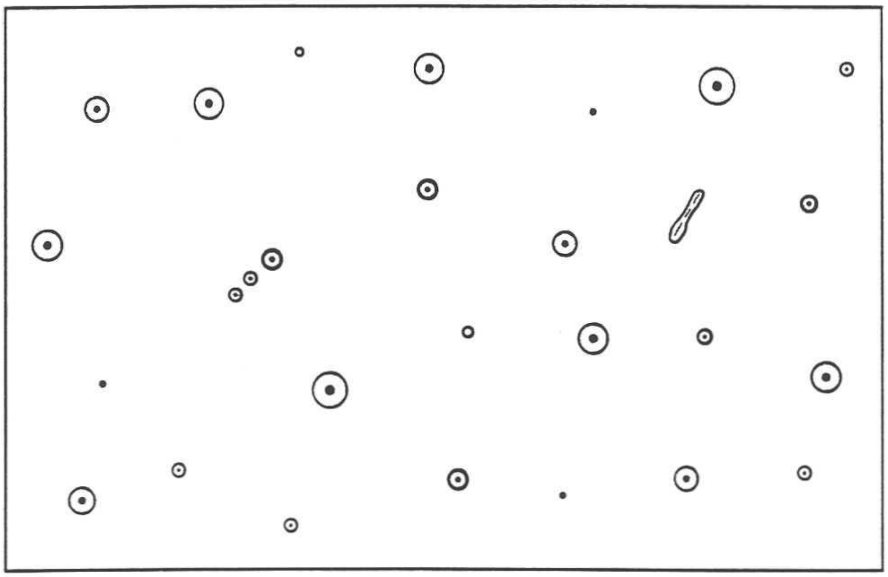
aligned



CLASSE **5**

Acceptance criteria : (density 25 o/oo)

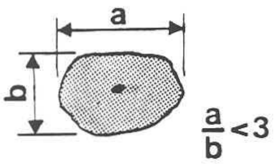
1) Threshold of accountability : a = 2 mm.
2) No rounded indication with a dimension of a > 8 mm.
3) No «linear» indication of a > 7 mm.
4) No «aligned» indication of l > 16 mm.
5) Total surface ot the indications in the range of 250 mm^2.



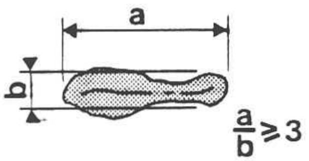
Note : As a reference, the above example contains 28 indications, 7 of which aren't taken into account. (a < 2 mm)
The total surface thus taken into accont is of 250 mm^2.

Definition of indications : (See PT 70-3 paragraph 4.1)

rounded



linear



aligned